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Enclosed is the specifications for

CU40026SCPB-T20A.

Regards.

VACUUM FLUORESCENT DISPLAY MODULE SPECIFICATION

Model : CU40026SCPB-T20A

SPECIFICATION NO.	:	DS-157-0000-03
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CU40026SCPB-T20A

1. General Description

1. 1 Application : Readout of computer, micro-computer, communication terminal and automatic instruments.

1. 2 Construction : Single board display module consists of 80 character (2 x 40) VFD, refresh memory, character generator, control circuit, DC / DC converter and all necessary control logics. Interface level is TTL compatible and the module can be connected to the CPU bus of host directly.

1. 3 Drawing : See attached drawings.

2. Absolute Maximum Ratings

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Logic Input Voltage	VI	0	–	5.5	VDC	–
Power Supply Voltage	VCC	0	–	7.0	VDC	–

3. Electrical Characteristics

Parameter		Symbol	Min.	Typ.	Max.	Unit	Condition
Logic Input Voltage	"H"	VIH	2.0	–	–	VDC	–
	"L"	VIL	–	–	0.8		
Logic Output Voltage	"H"	VOH	2.4	–	–	VDC	IOH=-2.0mA
	"L"	VOL	–	–	0.5		IOL=2.0mA
Power Supply Voltage		VCC	4.75	5.0	5.25	VDC	–
Power Supply Current		ICC	–	0.7	0.8	mADC	VCC=5.0V

Slow start power supply may cause erroneous operation.
ICC might be anticipated twice as usual at power on rush.

4 . Optical Specifications

Number of characters	: 80(2 lines x 40 chrs)
Matrix format	: 5 x 7 dot + Underline
Display area	: 188.55 x 16.0 mm (X x Y)
Character size	: 3.3 x 5.05 mm (X x Y)
Character pitch	: 4.75 x 9.95 mm (X x Y)
Dot size	: 0.5 x 0.55 mm (X x Y)
Dot pitch	: 0.7 x 0.75 mm (X x Y)
Luminance	: 350 cd/m^2 (100 fL) Min.
Color of illumination	: Blue-green

5 . Environmental Specifications

Operating temperature	: − 10 to +65 °C
Storage temperature	: −40 to +85 °C
Operating humidity	: 20 to 80 % RH
Vibration	: 10 to 55 Hz , 10 Gmax., 3 directions, 30 min. each
Shock	: 100 G , 9 mS.

6 . Functional Descriptions

This module provides the functions of 8 bit parallel and serial data write.
Each control data and character fonts are shown in Character Table 0 and 1.
All data write should be done during BUSY line is low.

$\overline{CS}$	$\overline{WR}$	Function	Bus direction
0	↑	Data write	Module ← Host
1	×	No operation	Module × Host

↑ : Rising edge of pulse × : Don't care

6 . 1 Character data write

Character font is displayed on the screen , and HT is excuted .
(see para . 6 . 2 . 2 HT)

6.2 Control data write

Detail of control data are shown in this clause. The term " Cursor " is the same meaning of " Writing Position ".

6.2.1 BS : Back Space (08 Hex)

The cursor moves one character to the left.
At the left end, it moves to the upper right end.
At the top left end, the cursor doesn't move.

6.2.2 HT : Horizontal Tab (09 Hex)

The cursor moves one character to the right.
At the right end, the cursor moves to the lower left end.
At the bottom right end, the cursor motion is depended upon DC 1 and DC2 mode.

DC 1 : The cursor moves to the top left end.
DC2 : All displayed characters are scrolled up one line.
The cursor moves to the bottom left end and all written characters in the top line is disappeared. The bottom line is cleared.

6.2.3 LF : Line Feed (0A Hex)

The cursor moves to the same column on the lower line.
At the bottom line, it is depended upon DC 1 and DC2 mode.

DC 1 : The cursor moves to the same column on the top line.
DC2 : All displayed characters are scrolled up one line.
The cursor keeps the same column on the bottom line, and the bottom line is cleared.

6.2.4 FF : Form Feed (0C Hex)

The cursor moves to the top left end.

6.2.5 CR : Carriage Return (0D Hex)

The cursor moves to the left end on the same line.

6.2.6 CLR : Clear (0E Hex)

All displayed characters are cleared. The cursor doesn't move.

6.2.7 DC 1 : Device Control 1 (11 Hex) ··· Character over write mode
DC2 : Device Control 2 (12 Hex) ··· Scroll up mode
Alternative LINE ENDING MODE is specified by DC 1 and DC2 when character data or HT or LF is written. Just after power on or initialize, DC 1 is selected (Default Mode).

6.2.8 DC4 : Device Control 4 (14 Hex) ··· Cursor is displayed on Underline.
DC5 : Device Control 5 (15 Hex) ··· Cursor is displayed as a blinking all dot character.
DC6 : Device Control 6 (16 Hex) ··· Cursor is turned to invisible.
DC7 : Device Control 7 (17 Hex) ··· Cursor is displayed as a blinking Underline.
Above four codes control the cursor rendition. DC4 is default mode. The mode is maintained until other mode is selected. The blinking speed can be varied by ESC sequence. (see para. 6.2.10 ESC)

6.2.9 CT0 : Character Table 0 (18 Hex) ··· International character font
CT1 : Character Table 1 (19 Hex) ··· KATAKANA character font

Above two codes select Character Table. Just after power on, CT0 is selected (Default Mode). Any characters from those 2 tables can be displayed on the screen by the bank selection.

6.2.10 ESC : Escape (1B Hex)
The character or data strings succeeding of ESC code control the various functions such as user definable font, cursor addressing, screen luminance control, selection of data writing mode, blink speed control and initialize.

(1) User Definable Font (UDF)

User's desired fonts can be defined by software. The fonts will be memorized in RAM of the CPU.

Syntax : ESC (1B Hex) + "C" (43 Hex) + CHR + PT1 + PT2 + PT3 + PT4 + PT5

Any 5 x 7 dot patterns consisted of data form PT1 thru PT5 can be stored in character code location specified by CHR.
Maximum number of UDF are 2 characters at once. Storing more than 2 will kill the oldest font. However, within the 2 character codes where already defined by UDF, the over-write-latest font replaces the former font.

1st byte : ESC (1B Hex)
2nd byte : "C" (43 Hex)
3rd byte : CHR (00 Hex to FF Hex)
Specify the character code location from 00 Hex to FF Hex by CHR.
If CHR overlaps the control codes such as BS, HT, etc., the control function will be lost. And therefore, overlap to the ESC code may not avail further UDF.
4th to 8th byte : PT1 thru PT5
Specify ON or OFF of 36 dot position (5 x 7 dot + Underline).
Following table shows the relation of dot position and the data formation.
("1" = dot turn on, "0" = dot turn off)

	7(MSB)	6	5	4	3	2	1	0(LSB)
4th byte	P8	P7	P6	P5	P4	P3	P2	P1
5th byte	P16	P15	P14	P13	P12	P11	P10	P9
6th byte	P24	P23	P22	P21	P20	P19	P18	P17
7th byte	P32	P31	P30	P29	P28	P27	P26	P25
8th byte	*	*	*	*	UL	P35	P34	P33

* : don't care UL : Underline

Following is the dot assignment.

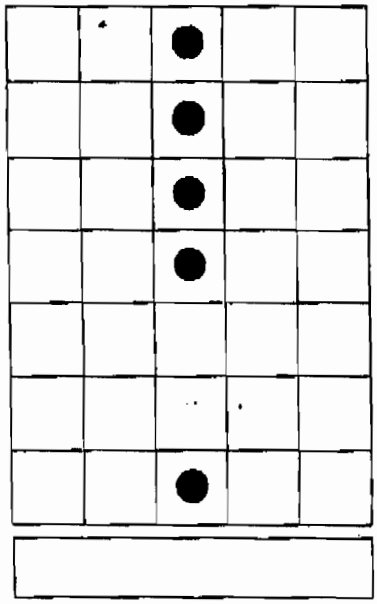
P1	P2	P3	P4	P5
P6	P7	P8	P9	P10
P11	P12	P13	P14	P15
P16	P17	P18	P19	P20
P21	P22	P23	P24	P25
P26	P27	P28	P29	P30
P31	P32	P33	P34	P35
UL				

After execution of above sequence, a defined font will be stored in the character code location "CHR" (Hex)

Following is an example of UDF sequence.

Example : "!" dot pattern should be stored in character code location A0 Hex.

Desired Dot Pattern



Turn on dot number

P3

P8

P13

P18

P33

Assign turn on dot number to the bit table as follows.

	7	6	5	4	3	2	1	0	Data (Hex)
4th Byte	1	0	0	0	0	1	0	0	84
5th Byte	0	0	0	1	0	0	0	0	10
6th Byte	0	0	0	0	0	0	1	0	02
7th Byte	0	0	0	0	0	0	0	0	00
8th Byte	0	0	0	0	0	0	0	1	01

Then Syntax should be written : 1B + 43 + A0 + 84 + 10 + 02 + 00 + 01 (Hex)

(2) Cursor Moving

The cursor can be moved any position of the screen by following ESC sequence.

Syntax : ESC (1B Hex) + "H" (48 Hex) + 1 Byte data

Column / Line	Left end	2nd	3rd	- - - - - ÷ -	Right end
Top	00	01	02	- - - - - - -	27
Bottom	28	29	2A	- - - - - - -	4F

Data = 50 Hex to FF hex : The cursor doesn't move.

(3) Luminance Control

The screen luminance can be varied by following ESC sequence.
Just after power on, the screen luminance is set to 100%.

Syntax : ESC (1B Hex) + "L" (4C Hex) + 1 Byte data

Data = 00 Hex to 3F Hex : approx. 30%
40 Hex to 7F Hex : approx. 50%
80 Hex to BF Hex : approx. 75%
C0 Hex to FF Hex : 100%

(4) Selection of Writing Mode

Flickerless Mode cab be selected by following ESC sequence.

Syntax : ESC (1B Hex) + "S" (53 Hex) ··· Flickerless Mode

Within Flickerless Mode, although BUSY might become longer, flickerless-high speed-continuous-data write can be achieved since refreshing of the screen has priority over the data acceptance.

Quick data write with minimum BUSY time will be given by Quick Write Mode since the data acceptance has the priority over the refreshing of the screen.
Within this mode, continuous high speed data write may cause flicker display.

Note :
When serial data write with high speed baud rate at Flickerless Mode, it may have the read error of the data . Busy check within Flickerless Mode or setting to the Quick Write Mode is recommended for serial data write.
Just after power on or initialize, Quick Write Mode is selected until other mode is set.
After selected Flickerless Mode, Quick weite Mode can't be selected unless otherwise Initialize.

(5) Blink Speed Control

Blinking speed of Block cursor can be varied by following ESC sequence.

Syntax : ESC (1B Hex) + "T" (54 Hex) + 1 Byte Data

Data = 00 Hex ··· 256
FF Hex ··· 255
FE Hex ··· 254
:
01 Hex ··· 1

Period of Blinking = Data Value x 30 mS
At power on default, 20 (14 Hex) is set to data.

(6) Initialize

All displayed characters and all setting factors are cleared by following ESC sequence.

Syntax : ESC (1B Hex) + "I" (49 Hex)

Execution of above sequence, module is reset as just after power on.

6 . 3 Test Mode

Test Mode is set by SIN(TO) is low more than 100mS at power on or initialize.
Durimg Test Mode, all character fonts are displayed automatically, and no any data are acceptable.

6.4 Character and control code table

Following 2 character tables can be selected.(see para. 6.2.9)

6.4.1 International character font

D7 D6 D5 D4	0 0 0 0	0 0 0 1	0 0 1 0	0 0 1 1	0 1 0 0	0 1 0 1	0 1 1 0	0 1 1 1	1 0 0 0	1 0 0 1	1 0 1 0	1 0 1 1	1 1 0 0	1 1 0 1	1 1 1 0	1 1 1 1
D3 D2 D1 D0	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0 0 0 0	0		SP	0	@	P	`	p								
0 0 0 1	1	DC1	!	1	A	Q	a	q								
0 0 1 0	2	DC2	"	2	B	R	b	r								
0 0 1 1	3		#	3	C	S	c	s								
0 1 0 0	4	DC4	$	4	D	T	d	t								
0 1 0 1	5	DC5	%	5	E	U	e	u								
0 1 1 0	6	DC6	&	6	F	V	f	v								
0 1 1 1	7	DC7	'	7	G	W	g	w								
1 0 0 0	8	BS	CT0	(	8	H	X	h	x							
1 0 0 1	9	HT	CT1	)	9	I	Y	i	y							
1 0 1 0	A	LF		*	:	J	Z	j	z							
1 0 1 1	B		ESC	+	;	K	[	k	{							
1 1 0 0	C	FF		,	<	L	\	l	|							
1 1 0 1	D	CR		-	=	M	]	m	}							
1 1 1 0	E	CLR		.	>	N	^	n	~							
1 1 1 1	F			/	?	O	_	o								

CFX101

Character Table 0

6 .4 .2 KATAKANA character font

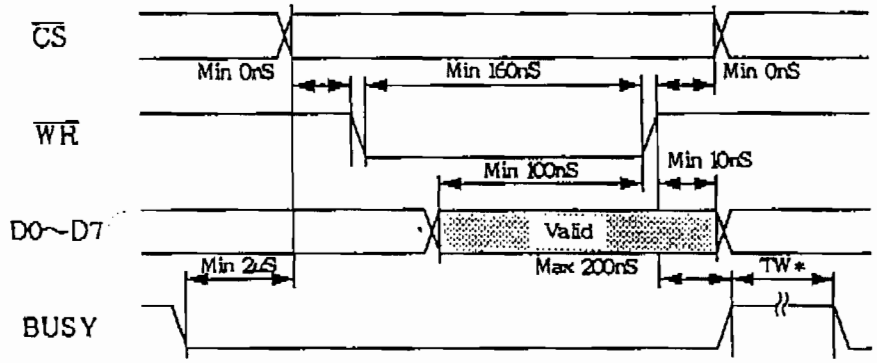
D7 D6 D5 D4	0 0 0 0	0 0 0 1	0 0 1 0	0 0 1 1	0 1 0 0	0 1 0 1	0 1 1 0	0 1 1 1	1 0 0 0	1 0 0 1	1 0 1 0	1 0 1 1	1 1 0 0	1 1 0 1	1 1 1 0	1 1 1 1
D3 D2 D1 D0	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0 0 0 0	0		SP	0	@	P	`	p								
0 0 0 1	1		DC1	!	1	A	Q	a	q							
0 0 1 0	2		DC2	"	2	B	R	b	r							
0 0 1 1	3			#	3	C	S	c	s							
0 1 0 0	4		DC4	$	4	D	T	d	t							
0 1 0 1	5		DC5	%	5	E	U	e	u							
0 1 1 0	6		DC6	&	6	F	V	f	v							
0 1 1 1	7		DC7	'	7	G	W	g	w							
1 0 0 0	8	BS	CT0	(	8	H	X	h	x							
1 0 0 1	9	HT	CT1	)	9	I	Y	i	y							
1 0 1 0	A	LF		*	:	J	Z	j	z							
1 0 1 1	B		ESC	+	;	K	[	k	{							
1 1 0 0	C	FF		,	<	L	\	l	|							
1 1 0 1	D	CR		-	=	M	]	m	}							
1 1 1 0	E	CLR		.	>	N	^	n	~							
1 1 1 1	F			/	?	O	_	o								

CFX102

Character Table 1

7 . Timing

7 . 1 Parallel Interface Timing



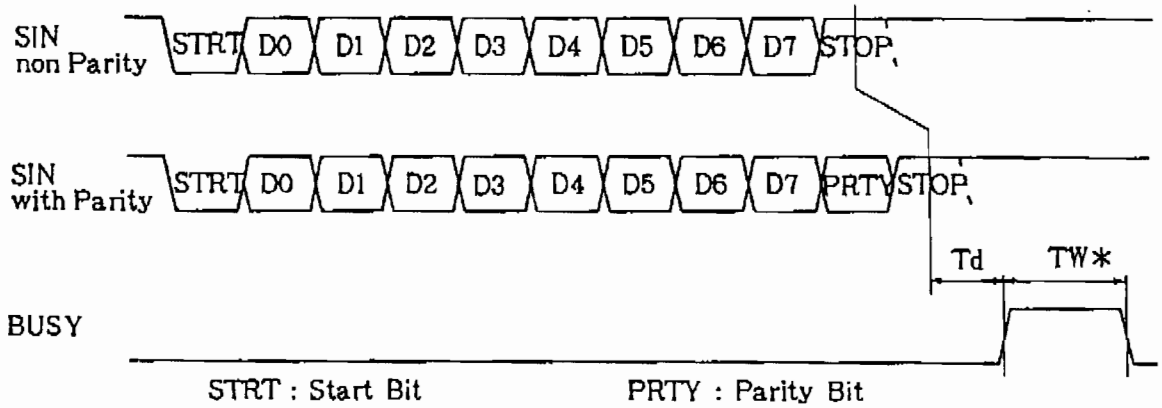
TW* : see para 8 . BUSY TIME

7 . 2 Serial Interface Timing

Serial data write, asynchronous-8bit TTL level is also acceptable.
Following baud rates can be selected by combination of the Jumper wires.
(see para . 9 . Jumper wires)

300, 600, 1200, 2400, 4800, 9600, 19200 BPS

Besides, parity bit-even, odd and non parity can be selected by 2 jumper wires.
(see para . 9 . Jumper wires)



STRT : Start Bit
D0 : LSB
:
D7 : MSB

PRTY : Parity Bit
STOP : Stop Bit

Td : 10 μS (Typ.) at Quick Write Mode
0 μS (Min.) ~ 800 μS (Max.) at Flickerless Mode

TW* : see para . 8 . BUSY Time

8 . BUSY Time

Input data execution time (TW*) at Quick Write Mode are shown as follows.

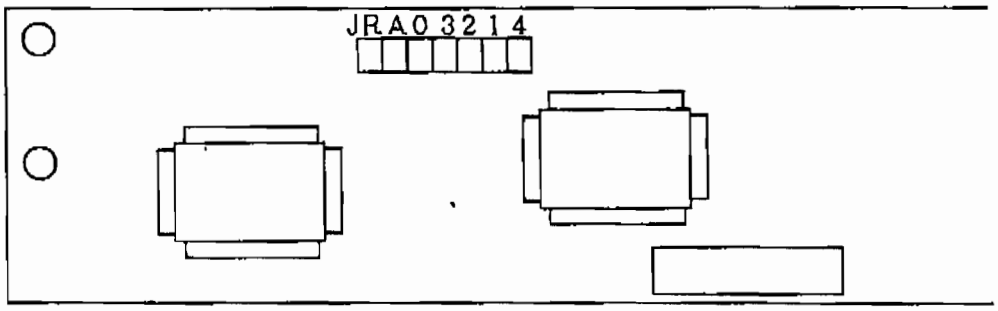
Data			Execution time (TW)		Data Writing Mode
			DC1 Mode	DC2 Mode	
Character Data, HT, LF			200 μS (Max)	1000 μS (Max) at scrolling	Quick write mode
BS, FF, CR, CT0, CT1 DC1, DC2, DC4, DC5, DC6, DC7			200 μS (Max)		
CLR			900 μS (Max)		
ESC	1st byte		200 μS (Max)		
	2nd byte	"C"	200 μS (Max)		
		"I"	1400 μS (Max)		
		Except "C", "I"	200 μS (Max)		
	3rd byte ~		200 μS (Max)		

Above execution time are only talking about Quick Write Mode as mentioned.

Within Flikerless Mode , Approximately 2 to 15 times of above table should be considered.

Operating with Flickerless Mode , therefore , always watching of BUSY line is recommended.

9 . Jumper wires



PCB PARTS SIDE

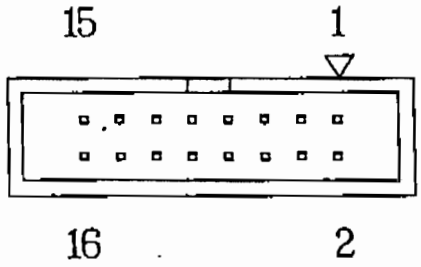
Jumper Function Table

JA	J4	J3	J2	J1	J0	Function	
×	×	×	1	1	1	Baud rate selection	19200 BPS
×	×	×	1	1	0		9600 BPS
×	×	×	1	0	1		4800 BPS
×	×	×	1	0	0		2400 BPS
×	×	×	0	1	1		1200 BPS
×	×	×	0	1	0		600 BPS
×	×	×	0	0	1		300 BPS
×	×	×	0	0	0		300 BPS
×	1	1	×	×	×	Parity selection	Even Parity
×	1	0	×	×	×		Odd Parity
×	0	×	×	×	×		Non Parity
1	×	×	×	×	×	Character font selection	International Font (CT0)
0	×	×	×	×	×		JIS Font (CT1)
1	1	1	1	1	1	Setting at Factory	

0 : Short 1 : Open X : Don't care

10 . Connector Pin assignment

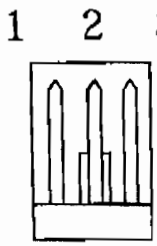
10 . 1 Data Connector



No.	Terminal	Connection		No.	Terminal	Connection	
		Parallel	Serial			Parallel	Serial
1	D7	O	NC	2	D6	O	NC
3	D5	O	NC	4	D4	O	NC
5	D3	O	NC	6	D2	O	NC
7	D1	O	NC	8	D0	O	NC
9	$\overline{WR}$	O	NC	10	$\overline{CS}$	O	NC
11	SIN/T0	NC	O	12	BUSY	O	O
13	GND	O	O	14	GND	O	O
15	VCC	O	O	16	VCC	O	O

O : Connection
NC : No Connection

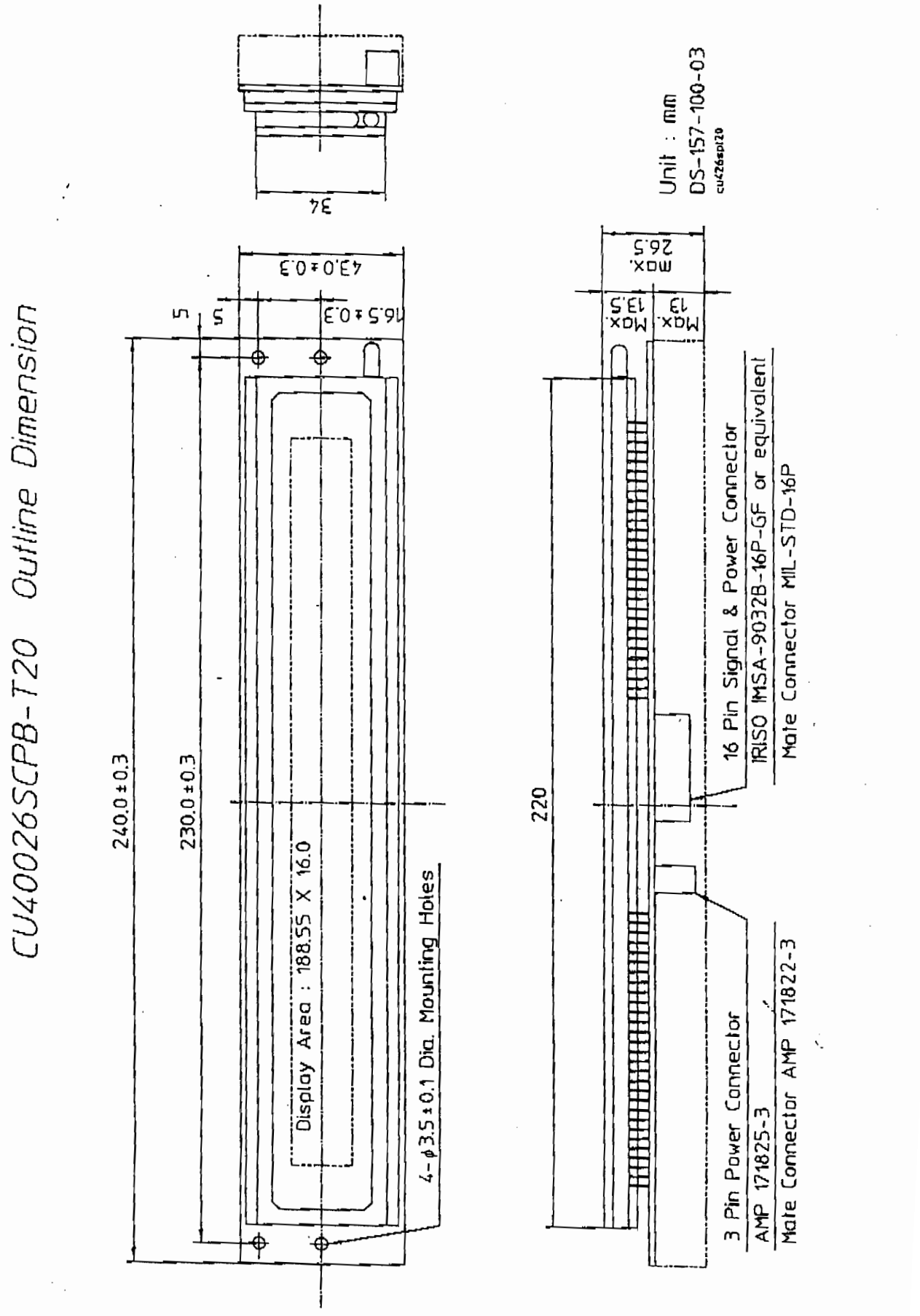
10 . 2 Power connector



No.	Terminal	Connection	
		Parallel	Serial
1	VCC	O	O
2	SIN/T0	NC	O
3	GND	O	O

O : Connection
NC : No Connection

11 . Outline dimension



IMPORTANT PRECAUTIONS

* All VFD Modules contain MOS LSIs or ICs. Anti-Static handling procedures are always required.

* VF Display consists of Soda-lime glass. Heavy shock more than 100 G, thermal shock greater than 10 °C/minute, direct hit with hard material to the glass surface -- especially to the EXHAUST PIPE -- may CRACK the glass.

* Do not PUSH the display strongly. At mounting to the system frame, slight gap between display glass face and front panel is necessay to avoid a contact failure of lead pins of display. Twist or warp mounting will make a glass CRACK around the lead pin of display.

* Neither DATA CONNECTOR or POWER CONNECTOR should be connected or disconnected while power is applied. As is often the case with most subsystems, caution should be exercised in selectively disconnecting power within a computer based system. The modules receive high logic on strobe lines as random signals on all data ports.
Removal of primary power with logic signals applied may damage input circuitry.

* Stress more than specification listed under the Absolute Maximum Ratings may cause PERMANENT DAMEGE of the modules.

* +5 volts power line must be regulated completely since all control logics depend on this line.
Do not apply slow-start power. Provide sufficient output current power source to avoid trouble of RUSH CURRENT at power on. (At least output current of double figure of Icc, listed on the specification of each module, is required)

* Data cable length between module and host system is recommended within 300 mm to be free from a mis-operation caused by noise.

* Do not place the module on the conductive plate just after the power off. Due to big capacitors on the module, more than 1 min. of discharging time is required to avoide the failure caused by shorting of power line.

* 2 hours pre-running with the test mode operation may help the stability of the brightness of the VFD when power was not applied more than 2 months.

* Steady repeating of a fixed (static) message displaying, longer than 5 hours in a day may cause the phosphor burn-out problem. An automatic shut down programming, scrolling message using DC2 mode or 2 hours test mode operation during the idling of the host is recommended.